Electronic International Interdisciplinary Research Journal (EIIRJ) ISSN 2277-8721
Bi-monthly Reviewed Journal Sep/Oct- 2013

ECOGEOMORPHOLOGICAL ASSESSMENT: A CASE STUDY ON LAND DEGRADATION OF BIRBHUM DISTRICT

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Abstract:

Ecogeomorphology is an important new branch of geomorphology which deals with the study of interactions between organisms and the development of landforms. Day to day the environment is degraded due to several factors. Among the factors, living organisms is the important factor which is affect geomorphic process and it's responsible for degrading environment. Ecogeomorphology is commonly used to describe studies that focus more on the amplification of erosion and deposition processes. It is fundamentally concerned with bidirectional influences of biota and landscape on each other.

The present study attempts to determine land degradation status of Birbhum district using visual interpretation of geo- coded IRS P6 and LISS-III satellite imageries, Topographical map and seasonal field observation in Birbhum District, West Bengal, India. In the study area, different types of terrain are found with different patches. Here most of the important terrain is Lateritic terrain. It is of detrital origin probably during the Pliocene and Pleistocene times as evidences of active degradation are noted in observed Lateritic patches. About 28.18% of the study area is degraded. Most of the evidences of active degradation are noted in Lateritic patches. Seven types degraded lands are identified in this area.

Key Words: *Ecogeomorphology, land degradation, desertification, degraded land status.*

Introduction:

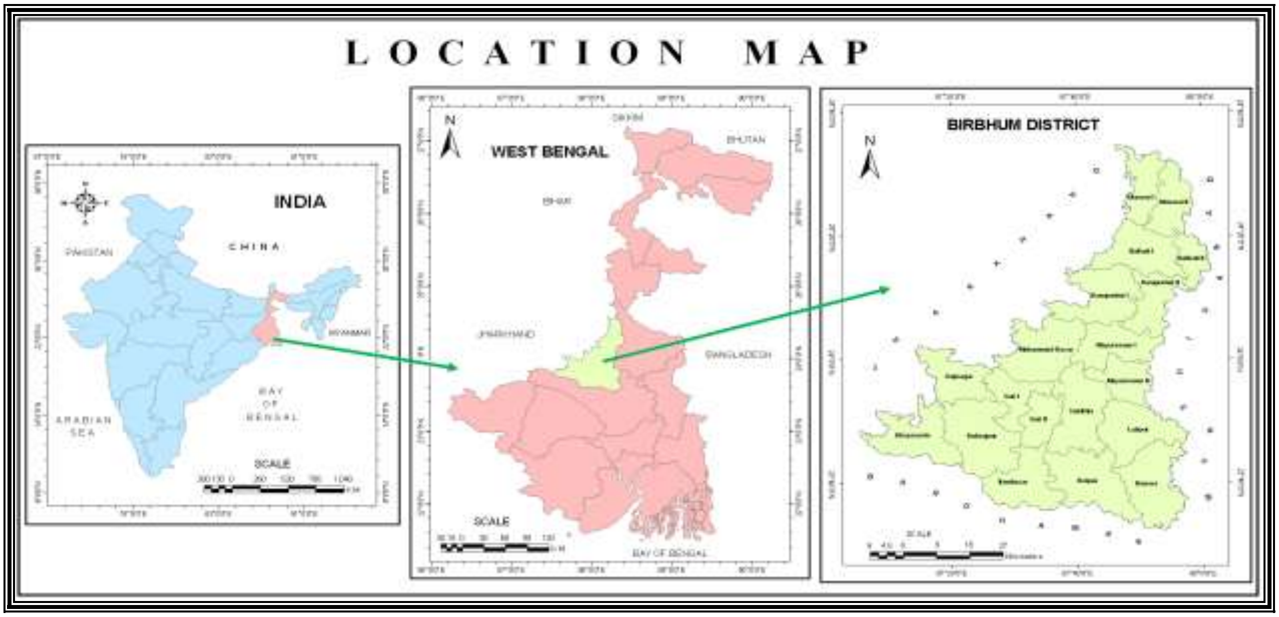
Eco-geomorphology is an interdisciplinary approach to the study of river System that integrates hydrology, fluvial geomorphology and ecology. Ecogeomorphology is an important new branch of geomorphology which deals with the study of interactions between organisms and the development of landforms. Examples of studies explicitly integrating ecology and geomorphology date back to at least the late 1800s (e.g. Cowles,1899), with more examples appearing in the 1950s (e.g. Olson,1958), and 1960s (e.g. Hack and Goodlet, 1960). The terms eco-geomorphology is become popular in the 1990s (Osterkamp and Hupp, 2010). The British geomorphology Research group annual Meating (Thornes, 1990) and the 1995 Binghamton symposium on bio-geomorphology (Hupp et al., 1995b) were two of first symposiums to emphasize the theme of bio-geomorphology. Ecogeomorphology and biogeomorphology are generally considered synonyms (Hupp et al., 1995a). Ecogeomorphology is commonly used to describe studies that focus more on the amplification of erosion and deposition processes (Jha., 2009). It is fundamentally concerned with bidirectional influences of biota and landscape on each other. Geomorphologists studying hillslopes and drainage basins have long recognized that biology affects sediment production and transport (Lancaster et al., 2003; Langbein and Schumm, 1958) and landscape morphology (Hack and Goodlett, 1960). Ecologists and some geomorphologists, on the other hand, study how topography and geomorphic processes affect biology (Stallins, 2006). One series of modeling studies steps back from the details observed in particular field sites to undertake an initial exploration of how the physical and biological processes and morphology all coevolves over long timescales in fluvial landscapes (Collins et al., 2004; Istanbulluoglu and Bras, 2005).

Study Area:

Study area lying between 23° 32' 30" and 24° 35' 0" N latitude and 88° 1' 40" and 87° 5' 25" E longitude forms of a part of the lower Ganga, referred to as the self lateritic alluvium locally known as Rahr Land (Spate 1967; Biswas, p.158; Jha p. 20, 2002). Administratively it is comprised of 19 CD blocks and 2467 villages under 19 police stations of Suri, Bolpur and Rampurhat Sub-divisions. The district extends over an area of 4545 Sq. kms.

Figure-1.1

Location of the Study Area



The study area belongs to the moderate morphogenetic region with prevalence of week mechanical weathering, strong chemical weathering, least wind erosion, moderate mass wasting, maximum fluvial erosion.

Geologically the study area is composed of the following geological formations:

1. Recent Alluvium (Kandi Formation),
2. Older Alluvium (Rampurhat Formation),
3. Laterite (Pliocene –Pleistocene),
4. Rajmhal trap (Jurassic to Cretaceous),
5. Gondwana Supper (Dubrajpur, Ranigang, Barren measurement Barakar Formations),
6. Archaean- Proterozic.

The total area of the district, the surface is broken by succession undulations, the general trend of which is form north- west to south-east. Near the western boundary they are rise into high ridge of laterite, separated by valleys a mile or more in width. To the south-east these upland ridges are less pronounced, while the valleys become narrower, and gradually merge into the broad alluvial plains of the Gangetic delta. The minor undulations are terraced up to the top. The rapidity with which hills change to ridges, to undulations, and undulations to level country varies considerably. The general elevation varies between 34m and 157m.

Methodology (Sources Of Data):

The study is based on primary source of data and secondary source of data. Secondary information needed for study are procured from the various publications, Topographical Sheet survey of India, Satellite Image LISS-III (Geo-coded IRS P6), Publication of National Bureau of Soil Survey and Land Use Planning (I.C.A.R.) and statistics i.e. District statistical Hand Book etc. The methodology adopted for carrying out this analysis could be categorized into 6 steps as follows:

- Image Rectification and Restoration
- Image Registration
- Digitization
- Data collection and analysis
- Ground truth verification
- Data analyses, data interpretation

After collecting the essential information required for this study, the digital analysis of these data was carried out through following technique.

- Morphometric analysis
- GIS analysis of all patches.
- Fournier index
- Universal soil loss equation (A=R K L S C P where A= Average annual soil loss (t/h/y),
- R = rainfall erosivity, K = soil erodibility LS =slope CP = existing cropping and conservation practice
- Laboratory testing

Result & Discussion:

Land degradation' means reduction or loss of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:

(i) Soil erosion caused by water;

(ii) Deterioration of the physical, chemical and biological or economic properties of soil; and

(iii) Long-term loss of natural vegetation.

According to WHO "Land degradation is caused by multiple forces, including extreme weather conditions particularly drought, and human activities that pollute or degrade the quality of soils and land utility negatively affecting food production, livelihoods, and the production and provision of other ecosystem goods and services." It has accelerated during the 20th century due to increasing and combined pressures of agricultural and livestock production (over-cultivation, overgrazing, forest conversion), urbanization, deforestation, and extreme weather events such as droughts and coastal surges which salinate land. Desertification, is a form of land degradation, by which fertile land becomes desert.

Degraded Lands As Noted In The Lateritic Patches And The Entire Study Area

The degraded land accounts for about 1281.06 Km^2 or 28.18% of the total study area where as degraded lateritic patches represents 185Km^2 or susceptible land (14.55%) (Table-1.3). Md bazaar is the worst affected C.D. block having the largest degraded lateritic patches (about 38.89 km^2 or 9.33%) and its coverage about 57.22 km^2 or 4.51% out of the total study area considering all geomorphic units. Eight types of degraded lands have been identified such as degraded forest (150.48 km^2 or 11.74% out of the total susceptible area), land with / without scrubs ((10.08 km^2 or 0.79%), Seasonal waterlogged area (90 km^2 or 7.02%), mining/queering (19.85 km^2 or 1.55%), sheet-rill-gully induced area (850 km^2 or 66.35%), Barren /rocky/stony/gravelly surface (60.65 km^2 or 4.73%), and Sandy terrain (36.95 km^2 or 2.88 %).

Electronic International Interdisciplinary Research Journal (EIIRJ) ISSN 2277-8721
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Lateritic patches as identified by (Table-1.1) Geocoded IRS P6 LISS-III Image Interpretation Keys of Patches of Birbhum District.

Lateritic patches as identified by remote sensing studies bear also these eight types of degraded land. Contributing factors of these adverse processes are aberrant weather, westward decreasing trend of rainfall and run-off, inherent susceptibility of highly weathered and leached acidic soils cape, queering of morrum and building stone, government policy for cutting of forest tree after each 10 years, forest blanks due to morrum exactions and intensive rain-fed agriculture practice. Major geo-environmental limitation of the study area is water erosion induced degradation through top soil loss and terrain deformations as evidenced by the highest coverage of sheet-rill-gully influenced area. About 14.55% or 185 km^2 of lateritic patches and 27.97% of the total study area experience such type of degradation. Over all concentration of degraded land is confined to the western part of the study area through they do not attain more than moderate severity. On the contrary degraded lateritic patches are frequent in the eastern and central part of the area and experience severe degradation at some localities (figure-1.3 and table-1.1 & 1.3). According to the above analysis, physical deterioration of landscape is evident.

Figure-1.1

View of land degradation of the study area

Table-1.1

Geocoded IRS P6 LISS-III: Image Interpretation Keys Of Lateritic- Patches and Degraded Lands

Geomorphic Units	**Image Analysis Tools**					**Location & Association**	**Area (Km^2)**
	Tone	**Size**	**Shape**	**Texture**	**Pattern**		
Lateritic patches	Green/Greenish White/Yellow blue	Very Small -large	Irregular- Regular	Coarse-mottled	Scattered/ contiguous	Level to undulating terrain, river and all types existing geomorphic units and land use/cove	**311.77 (6.86%)**
Degraded Forest cover	Light red/reddish white/ Oranges-Red	Varying	Regular	Moderately Fine Coarse	Scattered/ contiguous	Laterite Patch/Degraded Forest/Undulating Terrain	**15048 (11.74)**
Ravinous/ gully/Rill	Light yellow/White/very light brown	Varying	Irregular	Coarse Mottled	contiguous	Near River basin or Water Bodies/terrain deformation	**85000 (66.35)**
Scrubland (land with / without Scrub)	Light yellow/ Brown	Varying	Irregular /Regular	Fine	Scattered/ contiguous	Undulating Terrain/ Near River basin/ Laterite Patch	**1008 (0.79)**
Water logged area	Blue/Light Blue	Varying	Irregular /Regular	Fine	Linear/ Scattered/ contiguous	Along the river bed and Scattered space on Settlement	**9000 (7.02)**

Stream bank	Greenish Blue/white/light brown	Varying	Irregular	Moderately fine coarse	contiguous	Side of the Major River	**6305 (4.92%)**
Barren rocky terrain	Light Brown/Gray	Small/ Medium	Irregular	Fine	Scattered/ contiguous	Undulating Terrain	**6065 (4.73%)**
Mining	Blackish brown/light gray	Small	Irregular	Coarse Mottled	Scattered/ contiguous	Laterite Patch/Degraded Forest/Undulating Terrain	**1985 (1.55%)**
Sandy area	White	Small/ Medium	Irregular	Coarse	Linear	River bank	**3695 (2.88%)**

Source: NRSA (Govt. of India) computed from LISS-III image (through Image analysis tools and techniques of remote sensing data and G.I.S. technique)

Table-1.2

Types of degraded lands of Birbhum district

Degraded lands	Area (Km^2)	% of degraded land
Degraded Forest cover	150.48	11.74
Ravinous/ gully/Rill	850.00	66.35
Scrubland (land with /without Scrub)	10.08	0.79
Waterlogged area	90.00	7.02
Stream bank	63.05	4.92
Barren rocky terrain	60.65	4.73
Mining	19.85	19.85
Sandy Area	36.95	2.88
Total degraded land	1281.06	28.18
Total Geographical Area (Km^2) of Birbhum District = 4545.00		

Source: NRSA (Govt. of India) computed from LISS-III image (through Image analysis tools and techniques of remote sensing data and G.I.S. technique)

Figure- 1.2

Types of degraded Lands of Birbhum

Table-1.3

C.D. Block Wise Area of Degraded Lateritic Patches and Geomorphic Units

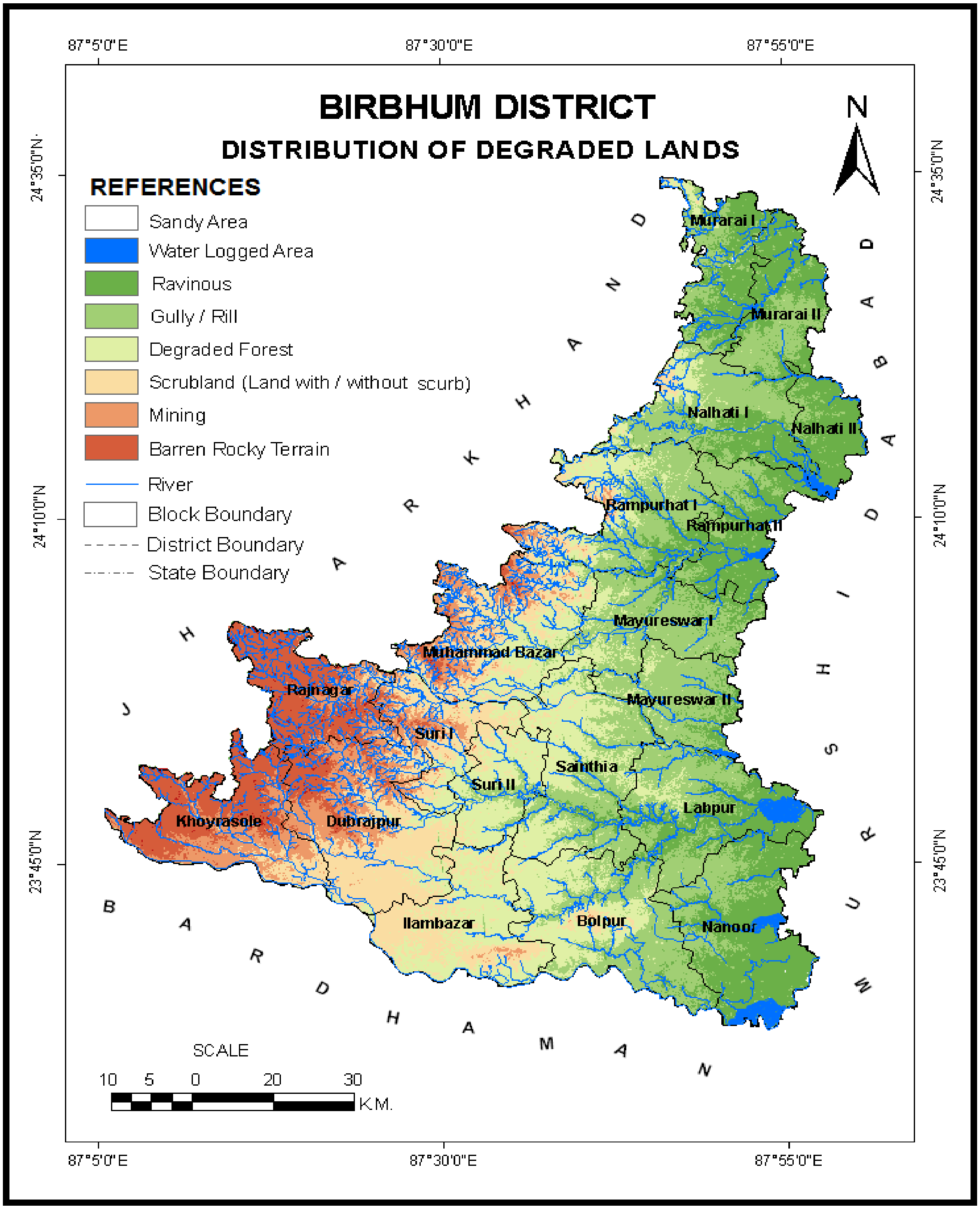
C.D. Blocks	Area of Blocks (Km^2)	Area (Km^2&%) of Lateritic patches (LP)	Area (Km^2&%) of Degraded Lateritic patches	Area (Km^2&%) of Degraded Geomorphic Units
Bolpur	335.31	27.63 (8.86)	17.79 (9.62)	73.47
Dubrajpur	361.71	48.64 (15.6)	36.65 (19.81)	89.86
Illambazar	261.54	26.02 (8.35)	19.44 (10.51)	66.47
Khoyrasol	272.19	55.63 (17.84)	38.36 (20.74)	62.35
M.D.Bazar	315.64	57.23 (18.36)	39.66 (21.44)	128.35
Rajnagar	221.47	32.32	24.77 (13.39)	96.25

		(10.37)		
SURI I	163.63	21.92 (7.70)	17.14 (9.27)	53.84
Suri II	135.81	10.77 (3.45)	8.46 (4.57)	42.23
Mayureswar I	224.83	3.81 (1.22)	2.06 (1.11)	41.05
Mayureswar II	156.57	1.98 (0.63)	0.99 (0.54)	49.68
Murarai I	175.51	-	-	62.73
Murarai II	185.33	-	-	48.44
Nalhati I	249.71	-	-	71.05
Nalhati II	109.15	-	-	62.33
Nanoor	311.83	5.44 (1.15)	3.85 (2.08)	62.04
Rampurhat I	292.97	2.95 (0.95)	1.63 (0.88)	73.71
Rampurhat II	181.55	-	-	67.94
Sainthia	312.27	13.99 (4.49)	9.47 (5.12)	65.66
Labpur	267.98	3.33 (1.17)	2.73 (1.48)	63.55
Total Area	4545.00	311.77 (100)	185 (100)	1281 (100)

Source: NRSA (Govt. of India) computed from Liss-III image (through Image analysis tools and techniques of remote sensing data and G.I.S. technique)

Figure- 1.3

Distribution of degraded Lands of Birbhum


BIRBHUM DISTRICT
DISTRIBUTION OF DEGRADED LANDS
N
REFERENCES
Sandy Area
Water Logged Area
Ravinous
Gully / Rill
Degraded Forest
Scrubland (Land with / without scurb)
Mining
Barren Rocky Terrain
River
Block Boundary
District Boundary
State Boundary
87°5'0"E
87°30'0"E
87°55'0"E
24°35'0"N
24°10'0"N
23°45'0"N
Murarai I
Murarai II
Nalhati I
Nalhati II
Rampurhat I
Rampurhat II
Mayureswar I
Muhammad Bazar
Rajnagar
Mayureswar II
Suri I
Sainthia
Suri II
Labpur
Khoyrasole
Dubrajpur
Ilambazar
Bolpur
Nanoor
JHARKHAND
MURSHIDABAD
BARDHAMAN
SCALE
10 5 0 20 30
K.M.

Suggestion:

Forests and tree cover combat land degradation and desertification by stabilizing soils, reducing water and wind erosion and maintaining nutrient cycling in soils. Sustainable use of goods and services from forest ecosystems and the development of agro-forestry systems can, therefore, contribute to poverty reduction, making the rural poor less vulnerable to the impacts of land degradation. Desertification and the associated loss of vegetation, causes biodiversity loss and contributes to climate change through reducing carbon sequestration. We should be recommended as solutions to land degradation problems of Birbhum district.

- For every tree that is cut, three, not two should be planted in its case. We have reached such a critical point that to prevent the desertification of the world that many more trees need to be planted.
- Unless it is necessary, water catchments areas should strictly be left alone.
- Quick growing varieties of soft wood trees should be grown for commercial uses e.g. making of furniture, pencils and paper.
- We should carry out consistent mass education on a worldwide scale, on the importance of reforestation and the dangers of deforestation.
- We need to enact and enforce strict laws against deforestation, worldwide.
- It is high time that we reduced our dependence on charcoal as a source of fuel and make use of wind and solar energy.

Nature works as a whole cycle. This is seen not only in animals where predator and prey work together but also in the different energy and nutrient cycles. As already explained earlier, forests play a crucial role in this equation.

Deforestation and desertification adversely affect agricultural productivity, the health of humans as well as of livestock, and economic activities such as ecotourism.

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